基于光谱红边参数的棉花黄萎病叶片氮素含量诊断研究

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Monitoring Nitrogen Contents in Leaves of Cotton under Verticillium Wilt Stress Based on Spectra Red-edge Parameters

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摘要 以黄萎病胁迫下棉花叶片为供试材料，分析了黄萎病棉叶氮素含量(LNC)与光谱红边参数间的关系，建立了黄萎病棉叶LNC(Leaf nitrogen content) 的光谱红边参数诊断模型。结果表明：(1) 随着黄萎病严重程度的增加，棉叶LNC逐渐减小，且差异显著；（2）黄萎病棉叶红边参数红边位置(REP)、红边振幅（Dr）、红谷位置(Lo)、红边深度（$Depth_{672}$）和红边面积($Area_{672}$) 均减小，红边宽度(Lwidth)增加，且$Area_{672}$的值减小的幅度最大，Dr减小的幅度最小，Lwidth的值增加的幅度较大；（3）黄萎病棉叶LNC含量均与红边参数REP、Lo、$Depth_{672}$和$Area_{672}$呈极显著正相关，与Lwidth呈极显著负相关，与Dr未达显著相关；(4)基于红边参数建立的黄萎病棉叶LNC含量的诊断模型均达到极显著水平（$P<0.01$），其中以$Area_{672}$为自变量建立的黄萎病棉叶LNC的诊断模型的精度最高，R^2超过0.7，RMSE小于0.6，RE小于0.007，能很好地诊断黄萎病棉叶LNC。

关键词：　棉花　黄萎病　胁迫　高光谱　红边参数　氮素含量　诊断模型

Abstract：　Using data from red-edge parameters of haperspectra, we endeavored to provide an expedient way to extract leaf nitrogen contents(LNC) of cotton infected with Verticillium wilt, and to lay the groundwork for estimating cotton yield infected by Verticillium wilt using remote sensing technology. The relationship between LNC and red edge parameters were analyzed, and diagnose models of spectra red edge parameters were established for cotton leaves infected by Verticillium wilt. The main results are as follows: (1) With the increase of leaf severity level, LNC little by little decreased, difference is significant. (2) In all red edge parameters, REP, Dr, Lo, $Depth_{672}$ and $Area_{672}$ all decreased, and the degree of decrease was maximum to $Area_{672}$ value, the degree of decrease was minimum to Dr value; but Lwidth largely increased. (3) LNC had best significant positive correlations with REP, Lo, $Depth_{672}$ and $Area_{672}$, had best significant negative correlations with Lwidth, and no best significant correlations with Dr. (4) Diagnose models of LNC to disease cotton leaves on the basis of spectra red edge parameters all attached best significant correlations ($P<0.01$). The diagnose models based on $Area_{672}$ had best estimated precision for LNC, and R^2 were over 0.7, RMSE less than 0.6, RE less than 0.007. So using red edge parameters of haperspectra monitor LNC of cotton infected by Verticillium wilt is accurate and convenient, and those models can better diagnose LNC.

Keywords：　cotton　Verticillium wilt　disease stress　hyper spectra　red edge parameters　nitrogen contents　diagnose models

引用本文:

陈 兵, 王方永, 韩焕勇, 刘 政, 邓福军, 林 海, 余 渝, 李少昆, 王克如, 肖春华.基于光谱红边参数的棉花黄萎病叶片氮素含量诊断研究[J] 棉花学报, 2013,V25(3): 254-261

CHEN Bing, WANG Fang-Yong, HAN Huan-Yong, LIU Zheng, DENG Fu-Jun, LIN Hai, YU Yu, LI Shao-Kun, WANG Ke-Ru, XIAO Chun-Hua.Monitoring Nitrogen Contents in Leaves of Cotton under Verticillium Wilt Stress Based on Spectra Red-edge Parameters[J] Cotton Science, 2013,V25(3): 254-261

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